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ABSTRACT

This handbook, using an input-process-output model, provides library managers with a method to evaluate network service offerings and decide which would be cost-beneficial to procure. The scope of services addressed encompasses those network services based on an automated bibliographic data base intended primarily for cataloging support. Sections cover: (1) cost-benefit questions; (2) identifying objectives, constraints, and alternatives; (3) comparing alternatives; (4) introducing network services into the library; and (5) evaluating the decision. (Author/KP)

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LIBRARIAN'S HANDBOOK
FOR
COSTING NETWORK SERVICES

Project No. 475AH50102
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ABSTRACT

There are a number of quantitative and qualitative factors to consider in evaluating and selecting offerings from different network service suppliers, and in deciding whether network services should be purchased at all. This handbook, using an input-process-output model, suggests methods for evaluation of the effect of alternative network services on the library's objective function as an aid to management decision-making.

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LIBRARIANS HANDBOOK FOR COSTING NETWORK SERVICES

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I. INTRODUCTION

The purpose of this document is to provide library managers with a method by which they can evaluate network service offerings and decide which would be cost-beneficial to procure. Network services are bibliographic and communications products and processes, mostly computer-based, which are offered by bibliographic utilities (e.g., OCLC, Lockheed, BALLOTS, Auto-Graphics) or service centers (e.g., NELINET, Bibliographical Center for Research (BCR), AMIGOS) to support technical processing, reference services or interlibrary loan.

There are few guidelines established for use in predicting the effects of network services upon an individual library's budget or upon the efficiency of library processes. Unfortunately, there is little empirical evidence that clearly proves that the cost-benefits of network services surpass the cost-benefits of traditional library operations. In part, the difficulty in evaluating the cost-benefit tradeoff arises from the inordinate number of variables that affect the usefulness of network services within the library. Despite this situation, the library manager is still confronted with the responsibility of selection from among a variety of network suppliers.

This paper provides a tool for managers for evaluating and deciding whether or not to procure network services, and which services from what suppliers to select. The scope of services addressed in this document encompasses those network services based upon an automated bibliographic data base intended primarily for cataloging support. Specific products offered may include acquisition capabilities, library location information, interlibrary communication systems, serials control modules, and the provision of products such as catalog cards, book catalogs, microfiche catalogs, etc. The diversity of product offerings available from the various suppliers requires careful consideration of each. For the purposes of this study, cataloging support (which is common to each supplier, and most conducive to measurement) is most often used by way of example than are other products and services.

The approach used in this study is one of a guide to considerations and concerns of which the library manager should be aware.

II. ANSWERING THE COST-BENEFIT QUESTIONS

So you think you need network services? Why? From whom? What will they really cost? What will you save? What will you gain? What will you lose? What are the benefits, and who will receive these benefits? Who is going to pay for these services, and how much are they going to have to pay? How can you increase the probability that you are making the right decision? The responsibility of demonstrating to the city council, the administration, the library user, the taxpayer or the funder that all the merits and disadvantages of major purchases have been considered falls squarely upon the shoulders of the library administrator. This Handbook is intended to provide a guide to assist you in meeting this responsibility to make good decisions in respect to acquiring network services.

Most of the information the library manager needs to answer the cost and value questions evolves logically from a rational decision process for selecting a "best" alternative from among several possibilities in an environment of uncertainty (i.e., where complete knowledge of present and future factors is not available). The decision-making process can be envisioned as a combination of:

a. Identification of objectives to be fulfilled by the decision

b. Identification of the needs and constraints that bound your freedom of action in selecting and employing alternatives

c. Identification of alternative courses of action, and selecting those alternatives that appear to be reasonably "good"

d. Valuation of alternatives, so you can choose the highest-valued alternative on which to base your decision.

Although decisions about network services are the subject of this Handbook, the suggested approaches can be used in reaching other kinds of decisions as well.

III. IDENTIFYING OBJECTIVES, CONSTRAINTS AND ALTERNATIVES

By the time the library manager has begun to consider network service alternatives, the first three steps of the decision process may be completed. Nevertheless, we will discuss them here before going on to describe how alternatives can be evaluated.

A. IDENTIFICATION OF OBJECTIVES

The objective function of the library can be regarded as the combined "value" of outputs of the library, subject to the resources (input levels) available to produce those outputs. This is far more complex a concept than is immediately apparent. Outputs of the library (service, circulation, preservation, reference, etc.) have for the most part qualitative rather than quantitative "values" (weights). The objective function of the library may be defined as the total value of the library to its users. The value of the library is then a function of those services which the library provides, and the relative utility of those services to the user population. If the objective function were constructed in mathematical terms, the relative utilities, or weights, of each of the services provided would act as coefficients in measuring outputs.

If the library were a profit-making enterprise, the objective function to be maximized would rely upon profit, or the measure of "best." For the library, however, the analyst must think in terms of "value" or "benefits" of the library outputs. Any assignment of value is necessarily subjective, although quantitative methodologies exist that can be used by the decision-maker in appraising these values (e.g., utility theory, trade-off analysis, cost-benefit analysis).

The goal of the decision-maker is to maximize the "value" function of the library. This can be done by increasing the "value" of one or more library services while the value of other services remain constant, or by increasing the values of some service while decreasing the value of others. The final "mix" of outputs will dictate the "value" function. The library administrator, or budget officer, is usually the ultimate judge of this "optimal" mix of outputs, depending upon the relative weights placed on each service. One might expect the objective function to include the value of the following library outputs:

- reference service,
- maintenance and control of collection,
- access to the collection,
- access to resources outside the library,
- collection development, and
- community outreach programs.

Clearly, this list is not exhaustive, and may be different for your library. The objective function is simply a total of the values of those products and services which the library provides to its users.

Normally, the way to maximize value would be to increase the number of outputs. This is, however, not always the most efficient way to augment value. For instance, value could be increased by improving the quality of outputs, or creating new kinds of outputs. It is the role of the manager to increase the library's capability to produce "value":

- by increasing the quality of one or more of the services
- by increasing the number of services offered
- by increasing the "value" of services to the user (i.e., improving their relevance to users' priority needs)
- by increasing the volume of services offered

The objective function is subject to the level of resources available to the library as inputs needed for production of outputs. The library cannot produce more than available resources will allow. The allocation of resources to inputs falls into four categories:*

- labor (professional librarians, library technicians, clerks, etc.)
- capital (buildings and equipment)
- land, and
- raw materials (bookstock, supplies. etc.)

A library has only finite (and usually very limited) resources for the procurement of inputs. The number and types of outputs is clearly a function of the number and types of inputs. Thus, the library manager attempts to conserve the volume of inputs during production in order to produce the maximum number of outputs (i.e., the fewer inputs required for production of a single output, the more output can be produced). Additionally, the library manager may look to alternative allocation patterns for resources to find more efficient (less costly) input patterns to produce the same level of value. You can choose to invest more in equipment and less in labor, for example.

The model we have been talking about is illustrated in Figure 1, which portrays the library as the producer of outputs using an array of inputs. Because the goal is to maximize the total value of a library's outputs, improvements must be made to the production process and/or the level or mix of inputs must be altered.

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* Managerial talents and luck can also be important inputs.

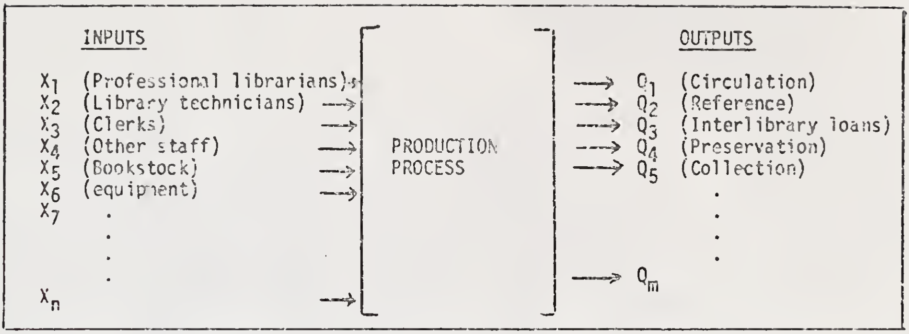

Figure 1. Input-output model

B. IDENTIFICATION OF NEEDS AND CONSTRAINTS

A need can be defined as the inability to adequately or efficiently meet the objective function, or to provide a service element of the objective function. This can have one of several causes:

- the requisite inputs are lacking (inadequate labor, insufficient bookstock)
- inputs are wasted during the production process (e.g., idle machinery, idle staff, excessive costs)
- resources are not used efficiently in the production process.

Where need exists, the library is prevented from meeting its goal of increasing the value function and the values of the services it provides.

The identification of needs is often more difficult than the library manager anticipates. The manager may be vaguely aware that processes are not running as smoothly as expected (output is falling, there is increased production waste, etc.), or that something is wrong in certain of the library's operations (e.g., faulty equipment, service quality is too low). The difficulty arises in translating these concerns into a concrete definition of need. Services may need improvement, or costs may need curtailment -- but how and where?

The process of locating the need (the gap between expectation and performance) is usually a matter of isolating (via exclusions) the single task or single input which is deficient. The set of needs can be extensive, including every area of the library where performance does not meet expectation, or where inputs are inadequate for production to maintain an adequate level of service (value). If procurement of network services is being considered, this might imply that the needs have been defined within one of the functions of technical processing or interlibrary cooperation. This, however, is not necessarily true. For instance, there is substantial evidence that network services can free labor input within technical services to assist (reallocation of inputs) in public services (e.g., reference, circulation). In other words, network services can promote more efficient use of other inputs (e.g., labor).

In some cases, network services may be defined as a solution, and an input, processing or output need must be discovered. For example, network services can enhance interlibrary cooperation or reference services (an output), reduce work per unit in processing, diminish staff requirements (input), reduce inventory (input), or reduce bibliographic and location tool requirements (inputs). Solutions other than network services may be available to satisfy any number of these needs. It is beyond the scope of this Handbook to investigate other interventions, but the manager is urged to do so.

Network services represent a difference in existing inputs and outputs for the library, and may -- or may not -- increase the value function of the library. Objectives set for network services should be consistent with the overall goal of the organization: to increase the value function.

Summarizing the objectives of network services for the library, one might expect to find the following:

- to increase processing capability (increased outputs with the same input levels)
- to increase greater access to bibliographic information (increased input with overall effect of increase in value)
- to diminish staff requirements (decreased labor input with same level of output)
- to reduce costs (decrease in one or more inputs, with no increase in other inputs to achieve equal value), and
- to encourage cooperative development (increase in output without increase in input)

Clearly, this list is not exhaustive. The reader will quickly note that these expansive goals may conflict. It is rarely possible to decrease costs and increase value simultaneously. Goals are subject to the level of services targeted and to the restriction of resources allocated to provide services.

C. IDENTIFICATION OF ALTERNATIVES

Alternatives must be limited to those falling within a "feasible region." For example, if an alternative requires more labor than would be feasible for the library to obtain, the alternative is infeasible and need not be considered. Similarly, if an alternative requires more capital investment than the library can afford, the alternative can be ignored.

The feasibility of an alternative is dictated by the constraints placed on the library. Normally, constraints are considered to be input constraints (the upper limit of resources available to the library). The library has only limited resources which can be invested in production. Any solution, or selection, the library manager makes in order to increase the value of the library (or, the adjunct: reduce the costs of production) must be within the scope of these resources. These feasible alternatives are defined as members of the opportunity set. Further, these constraints are dependent: If the library invests all available funds in staff, then there is nothing left to invest in equipment. Therefore, the system of inputs must be looked upon as conditional. If money is invested in network services (a potential input) then funds are diverted from other inputs. Further, there is the level of management "willingness" to invest in network services. For example, given the choice between four new funded positions and the equivalent amount devoted to the network service, which would the library manager choose? And to what extent, without the choice, would management be willing to invest in network services? This is, of course, in part based upon the expected returns (increase in value of library services, or savings in producing library services) the library manager foresees.

The availability of alternatives is dependent upon other constraints of the library and a parallel set of constraints upon the supplier. There are also constraints other than those on inputs which must be considered:

- legal restrictions;
- geographical location;
- building codes; etc.

Constraints can include: legal (and administrative, procedural) restrictions in contracting for services; geographical distance to the supplier of the service; building restraints (e.g., lack of space); and inadequate facilities to access the network service (e.g., lack of communications). Additionally, the network service suppliers may be bounded by legal, geographical or technical constraints. These dual sets of temporary (i.e., they will change in time) restrictions can serve to limit the number of alternatives the library has to consider at this time. It is unreasonable to include as an alternative a network service supplier which cannot presently serve the region in which the library is located, or which cannot legitimately contract service to the library. Obviously, if the requirements of the network service exceed the constraints of the library, or the requirements of the library exceed the constraints of the service supplier, the alternative can be excluded from any additional assessment.

IV. VALUATION OF ALTERNATIVES

Valuation of alternatives is performed to identify the "best" alternative. This is not necessarily the lowest cost alternative. It is that alternative which adds the most to the library's objective function at the relatively lowest allowable cost increase. In other words, that alternative which augments the value of the library at the least cost per unit of value increase. The judgment of the library manager is perhaps the single most important factor in this decision. To quote the annual reports of the War Department for the Fiscal Year Ending June 30, 1902, report of the Secretary of War:

> Where mathematical models and computations are useful, they are in no sense alternatives to or rivals of good intuitive judgment; they supplement and complement it. Judgment is always of critical importance in designing the analysis, choosing the alternatives to be compared, and selecting the criterion. Except where there is a completely satisfactory one-dimensional measurable objective (a rare circumstance), judgment must supplement the quantitative analysis before a choice can be recommended. (as cited in Hitch, Charles. Decision-making for Defense, University of California Press, 1966, Berkeley, p. 53)

It is the library manager who is accountable for the decision to purchase network services, and his/her responsibility to make the decision. A quantitative valuation of alternatives will help greatly in providing a basis for making the decision, but it will not replace "good judgment."

The process of valuation may begin by determining the impact points (i.e., the areas of library service affected by network service) and the expected goals which will be achieved (e.g., the fulfillment of an expressed need, such as defective processing, or wasted resources).

Those goals formulated from expressed needs represent the foci of network services, where measurements should be established to monitor the progress towards the library's goals. The role of measurement in evaluating network services against the perceived needs of the library requires rigorous definition of inputs, outputs and processes, and similarly of the measurements to be made.

A. MEASUREMENTS

The construction of measurements is an essential step in evaluating and controlling activities. Measures are used to monitor growth, efficiency, and standards. Similarly, measures define the impact of new services and products. Though measurement of production lines and precision counts of manufacturing inputs and outputs are well understood, measures applied to library service are less easily defined. That is not to say that measurement is not required in the library, as well as in manufacturing. There must exist some indicators of performance. Innumerable suggestions for what to count and how to count it have been put forward for possible library use. However, the possible measures for this discussion are limited to those relevant to the goals for network services.

Measures are often constructed around the input to output ratio; e.g., dollars per unit of output; dollars per unit increase in value function (i.e., how much money would be necessary to raise the value function by one unit); labor per unit of output. However, other measures exist to monitor the allocation of inputs (e.g., labor dollars expended to book budget expenditures, professional labor to non-professional labor) or the allocation of outputs (circulation to interlibrary loans, etc.). Potentially, we would look to network services to decrease inputs (e.g., labor, supplies, etc.), to improve processes (e.g., reduce turnarounds, reduce original cataloging requirements) or increase outputs (e.g., provide cataloging for non-book materials). Thus, we might include the following measures for determining how network services could affect the library:

- cost per unit processed (input to output ratio)
- units processed per labor invested (output to input ratio)
- turnaround (process measure)
- fill rates of interlibrary loan (output measure)

In order to define those measures which are most appropriate, the library manager must begin to define the changes expected to stem from network services.

Techniques of measurement that a library manager might use have been developed in the fields of systems analysis, production management and work measurement. Here we would like to note a few of these techniques.

TIME AND MOTION STUDIES

Purpose: To determine the time for particular physical motions of a single task, so that appropriate adjustments can be made to abbreviate the operation.

Technique: Stop watch observations of each distinct motion performed by the operator, including the monitoring of right hand and left hand operations.

Resultant: The data collected will reflect the time (in seconds or tenths of a second) of the operator's process activities and physical motions.

Advantages: Only a few observations of the process are required for a repetitive process in order to yield a relatively accurate estimate of time spent in a process. Unnecessary motions can be detected almost immediately. The staff member does not have to monitor his/her own time.

Disadvantages: Stop watch observations tend to place the operator on the defensive, and under some pressure. The resulting data are too detailed for the purposes of determining the impact of network services since the data reflects the detail of physical movement of an entire operation which would be replaced by network services. The technique is most useful in monitoring repetitive operations, and may be valueless in monitoring activities such as original cataloging.

FREQUENCY AND INCIDENCE OBSERVATIONS (INTERRUPTION TIME STUDIES)

Purpose: To determine the frequency and percent of staff time spent on particular activities.

Technique: At random intervals, the staff member is observed to determine what particular activity s/he is conducting. No notation is made on the amount of time spent on that particular activity.

Resultant: The resulting data gives the analyst an estimate of the frequency of an operation and the percent of time spent on a particular activity.

Advantages: Relatively few observations are necessary. The resultant offers an estimate of the percentage of time devoted to those change candidates. The staff member is not responsible for monitoring his/her time.

Disadvantages: There are no units of measure for work throughput to determine the relationship between times and volume. This method is more conducive to monitoring non-production activites, such as secretarial support, administration, etc.

DIARY METHOD

Purpose: To account for the staff time spent on activities during the day. Can be used for estimating the average time and staff costs per item.

Technique: During the day, the staff member notes the beginning and ending times of each unique activity. Volume processed or handled may also be noted. Another manner by which staff time can be noted is to use a form indicating time intervals during the day (a 15-minute interval is normally acceptable), in which the staff member notes the activity of that interval.

Resultant: The data taken from the diary method gives the analyst an amount of time spent on each type of activity during the day. If volume is requested, this data also will yield some information on the unit times and staff costs.

Advantages: This method yields unit times and costs, within an acceptable level of error.

Disadvantages: Requires staff time in data collection, which can harm or inflate the results if included in the task. Requires staff members to collect their own time, which can be harmed by subjectivity. Materials may be double counted, if more than one staff member performs some activity in the same item. Fails to account for variances in the types of materials processed.

LOGS

Purpose: Accounts for the staff time spent on any particular item, thereby giving an accurate assessment of unit times with some indication of variance according to the type of materials, subject area, etc.

Technique: A log is included in a sample of incoming materials to be processed through the department under examination. Each staff member that handles the item notes his/her time spent on a particular activity regarding the processed item.

Resultant: The resultant is a cumulation of times spent on processing particular items, with an estimate of the variance in processing the items. Also gives the analyst an idea of queue (backlog) behavior, as well as the number of handlings which each item receives.

Advantages: The gathered data gives evidence to the variances in processing times, thereby avoiding the inaccuracies that an average can give. Also, this methodology avoids the problem of double counting which is inherent in some of the other techniques.

Disadvantages: The nature of the log accompanying the item may be subject to human error (forgetting to fill it out) or lost in the multiple handlings of materials. The log cannot accompany certain processes (card reproduction) so this information must be acquired elsewhere.

INFORMAL RECALL

Purpose: To estimate the staff member's times and unit times on activities, through the use of recollection.

Technique: Information is gathered through the mode of interview, requesting the staff member to estimate the time s/he spends on the average processing units of work.

Resultant: Subjective average times devoted to work units.

Advantages: The data are quickly and inexpensively gathered. Data collection does not interfere extensively with the normal operations of staff. Depending upon the experience of the staff member, and "sense of time," the data may be surprisingly accurate.

Disadvantages: The data collected may be error-ridden due to the subjective impressions of the operator, or the unwillingness or inability to accurately assess his/her time.

MIXED METHODOLOGIES

Any number of the above, or other, methods can be employed by the library manager in analysis. For instance, the informal recall can be used as a hypothesis to be tested by another method. If the hypothesis is within a relevant range, then data collection can be abbreviated. The log technique can be used on certain tasks with large variances, while the diary technique can be used on rote tasks.

B. VARIABLES TO BE MEASURED

The prediction of impact points and evaluation of alternatives is a complicated process involving uncertainty and subjectivity. At best, we can include those obvious variables most apt to affect effectiveness and cost. At worst, we can ignore this step completely and rely only on guesses or salesmen's promises. Ideally, the definition of every variable would assist the library manager in making the optimal selection of a service. In reality, our information is imperfect. The most notable variables to consider, however, are:

a) Direct Costs of Network Services

- equipment,
- communications,
- use charges,
- product charges,
- service charges,
- discounts, and
- "free" products and services.

b) Utilization of Network Services

- the products which the library will purchase,
- the expected volume of products to be purchased,
- library policies affecting utilization, and
- the expected "hit" rate for types of use.

c) Impact on Traditional Processes

- the activities which will change,
- the amount of change,
- the effects upon costs of these changes, and
- associated equipment and supply changes.

d) New Processes

- the new activities caused by network participation,
- the expected staff utilization of those new activities, and
- the associated costs of those activities.

Our major concern are those variables which impinge upon costs. There are a variety of definitions of "costs." For our purposes, two concepts of cost are most appropriate. First, costs can be interpreted to mean what we must pay for certain products and for the production of certain other products. These costs include the dollar outlays for procured raw and finished products, the investment in housing, salary expenditures, and support services (payroll, personnel, etc.) costs for the maintenance of production lines. In our context, the production line is interpreted as both the operation that acquires, manipulates and finishes incoming materials (from acquisitions to materials finishing), and the processing of interlibrary loan and reference requests from initial inquiry to completion. Clearly, this definition excludes the costs of storage, circulation, and several customer services -- those costs not clearly impacted by network services. A second relevant concept of cost considers all the options sacrificed by purchasing network services. For instance, if a library abandons traditional processes to join a network, there are certain requirements which are eliminated (e.g., the library no longer requires manual processing files) and certain requirements which are increased (e.g., committee responsibilties, meetings with the supplier). These trade-off factors need to be understood.

Another definition appropriate to our purposes is that of benefit. We wish to assume benefit as an increase in the value of the library, either through an increase in the amount or quality of services, or an increase in the types of service.

1. Direct Costs of Network Services

As a starting point, the direct costs of network service alternatives are the most obvious bases for comparisons between suppliers. Pricing algorithms used by suppliers vary but usually include: use charges, communications charges, product prices, service charges, equipment costs, discounts and "no-cost" products and services. Use charges are normally assessed by the number and types of use (e.g., searches, inputs, and updates) or by the number of records from the data base used in product production. If attached to every type of use, then a clear cost assignment can be made to the functional area of use (e.g., cataloging or acquisitions). However, if use charges are only assessed for record production (and not for record use), there is no efficient manner of allocating costs. In such charging algorithms, the costs of other types of use (e.g., searching for interlibrary loan locations) are included as an average overhead cost on record production. This latter type of charge must be weighed with caution when comparing the costs of either manual processes, or with the costs of other network service suppliers who use a different charging algorithm. Because it is based on a guess about volume of use and impact on production resources, the supplier's prices can change suddenly and drastically.

Communications are generally charged either as an overhead in the total price of the product purchased, or directly according to the connect time (actual time spent in communicating with the computer). The amount of these costs depend upon the communication carrier used, and may vary with the geographical distance between the library and the central computer or may be a flat rate. Equipment costs include both rental and depreciated investment. A straight line depreciation over five years is usually sufficient (i.e., 20% of the investment is accounted each year) for costing network service equipment purchases. Service charges include cost of training, equipment maintenance, and consulting. Catalog and profiling costs (if any) are normally associated with these service charges. The most obvious problem incurred in accounting for these costs of communications, equipment and services is the difficulty of assigning the cost to a particular use (e.g., searching for acquisitions, or searching for cataloging). This is next to impossible when these charges are included as an overhead cost to a product, rather than by type and rate of use. The most equitable manner of accounting for these costs is to prorate them against the type of use; however, the easiest way is to assign them to the primary common user (e.g., the cataloging department). When comparing potential costs of various network suppliers, though, it is more appropriate to attempt to prorate these costs so that alternative services can be compared on a type-of-use basis.

Services and products which are free of charge can be promotional gimmicks (e.g., free twenty-day trials), reinforcement of consumers (free consultation), or overhead functions too difficult to cost separately (e.g., searching). Such services and products need inclusion in the assessment of network alternatives, regardless of the "no cost" appearance because they do, of course, represent a portion of the supplier's costs.

Discounts can take several forms and should be incorporated into the cost estimate for network services. Discounts for high utilization as a credit mechanism encourages large volume purchases. Discounts should be factored into cost predictions if the volume of the library will warrant such discounts. Other forms of discount can include free use of records after first-time record production, or free use of records which the library inputs.

By combining these factors of the supplier's price for network services into a coherent set of costs associated with a particular type of product or use of the terminal, the library manager can begin to measure the costs of one service against another.

2. The Benefits of Network Services

Some of the benefits of network services are concrete, but many may not be obvious or easily measurable. For example, the terminal may provide a public relations tool for impressing governing boards, public, and funders, The benefits may potentially include interlibrary locations, increased cooperation regionally, equalization of interlibrary loan traffic (this is open to disagreement) and spin-off products (e.g., statistics). The statistics on processing, and system use, generally unavailable in the manual system, can be provided. However, there is often no clear substitution of statistics provided by the system for those provided manually.

Many of the benefits of network products are clear-cut:

- increased cataloging throughput
- increased quality of cataloging
- increased control of collection, serials, etc.

- reduced labor requirements for cataloging
- reduced catalog card supply requirements, etc.

Cost substitutions (though estimates) can be made. For example, if one less cataloger is necessary, we have reduced costs by the amount of that employee's salary and associated fringe benefits and support equipment costs (e.g., chair and desk), and increased costs by the costs associated with the network service.

Other benefits are not as obviously assessed. For example, cost-savings assigned to the availability of statistics are the costs which would have been necessary to gather the statistics manually (i.e., labor for collection and analysis of the statistics). However, the data may not be "worth" the costs of manual collection to the library manager. The only value then in the statistics provided by the network service is the amount the manager would be willing to pay for these statistics.

Reference capability has a point of comparison with the cost of doing similar searches manually. However, the assignment of "value" to those citations which would not have been found via a manual search is at best problematic. There is the value of the citation, the value of the user waiting time (presumably a manual search will take more time), the value accrued (to research, to profits of the corporation, etc.) brought about by the citation, etc. The same issue is apparent in the evaluation of interlibrary loan support provided by the network service. There is no accurate measure of the dollar benefits that are supplied by the availability of an additional location. In a directed network where specified libraries are to be queried, before passing the request out of the regional ILL network, the benefit depends wholly upon whether the "first choice" library is a participant in the network.* Further, the benefits to interlibrary loan depend upon the impact to the fill rate and the proximity of the library to other libraries in the network, and not necessarily upon the number of locations found.

ILL fill rates and turnaround times (request initiation to request completion) are considerations in network benefits. Turnaround times are assumed to be a function of distances between libraries, types of materials requested, and the probability of ownership. The probability that libraries exist within a limited radius of the subject library, and that they have a reputation for quick turnaround, determines the viability of a network service as an interlibrary loan tool. Further, the length of time these libraries have been members of the network and their rate of throughput will affect the volume of "usable" holdings in the network's data base. The availability of citations for the most recent acquisitions of member libraries is an advantage that networks may have over the printed bibliographic tools available for ILL use. Parallel to this advantage is the risk that requests are issued to libraries before materials are even out of the processing department.

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* The availability of location information for a number of libraries within a region and the freedom to direct requests to any of those libraries encourages the growth of an informal non-directed network. In fairness to the theory of a directed network, non-directed networks can encourage the utilization of (and burden) a few larger libraries within the region and discourage the controlled and logical disbursement of requests that directed networks can enforce.

Measuring the relative fill rates (the number of requests filled divided by the total number of requests) is not entirely adequate for comparison purposes. Consideration need be given to the number of queries made prior to actually filling or cancelling a request (the average number of passes). Examining the reasons for unfilled requests is helpful:

- non-circulating,
- in use,
- not owned.
- cannot identify.

In all likelihood, those requests which cannot be filled due to circulation status will remain constant regardless of network services. Clearly, though, those reasons for non-compliance because the materials are not owned or could not be identified by the queried library should be reduced by the use of network services. Drawing this information into focus, we note that network services may augment the fill rate of interlibrary loan services, by improving the likelihood of ownership and by providing an identifier (data base record number, or data base verification) for the queried library. This increased fill rate, and reduced number of passes, promise to lower the costs of processing requests (eliminating re-requests) and the costs to the patron (if a value can be associated with user time).

These potential impacts of network services upon interlibrary loan must be compared with present system benefits. The use of interlibrary loan facilitators (e.g., bibliographic centers, switching centers) may provide equal service and turnaround as that expected with network services. If the price associated with these centers' services includes such labor costs as bibliographic verification and successive passes, then network services (which still require local staff for bibliographic verification and rerouting of requests) may not predict a savings. In analysis of such a configuration, consideration of the prorated costs of bibliographic tools, terminal charges and labor costs for verification, terminal use, and routing of requests must be weighed against the transaction costs of a bibliographic center, and the labor necessary for using center services. Assuredly, added concern should be given to the relative fill rates and turnaround times of both services as well.

3. Utilization of Products and Services

Utilization of products and services relates to the content of the data base, hit rate, and prices and diversity of the services offered.

Whether the network services can be used in ordering, claiming, reference searching, authority control, or interlibrary loan is significant to the impact upon present library operations, the payments the library will be making to the network supplier, and the expected areas of value increase. Once both the types of products and the scope of the data base have been discerned, the library manager can begin predicting the amount of materials which could be routed through the service if available.

The diversity of products and services offered by each of the network suppliers determines the uses which the library can make of network services. Whether the network service can be used in ordering, claiming, reference searching, authority control or interlibrary loan is significant to the costing of services. Beyond the capabilities of the network alternatives to provide service, the policies of the library in using these services influence utilization, and costing. If interlibrary loan use of network services will only be in instances of "last resort," then the effectiveness of the service for this purpose is insignificant. Products and by-products provided by each of the alternatives need rigid definition to determine the impact points within cataloging, acquisitions, interlibrary loan, reference and serials. Speculation regarding the expected level of use (extent or volume) of network services is subject to gross error. Nevertheless, such estimation is necessary for the appraisal of the relative values of the alternatives.

The extent or size of the data base owned by the network alternative determines: 1) the types of materials which will be processed with network services; and 2) the estimated "hit rate," the number of records found in the data base divided by the number of records searched. Estimation of the hit rate is fundamental to the prediction of the percentage of throughput which will require manual processing.* The possible hit rate for each of the alternative data bases will vary not only with the particular data base and its intended use, but also with the size and type of using library. For instance, the small public library may be more apt to approach a 100% hit rate than a special library concentrating on highly technical or esoteric materials. It is useful to survey other similar-size and similar-type libraries currently using these services to determine the expected hit rate your library can anticipate. Other factors may influence hit rate. For instance, the number of searches conducted for the same item prior to routing the item through manual systems can affect the probability of finding the item. A record is more likely to appear in the data base at successive searches after the first unsuccessful search (especially for more recent imprints).

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* There is evidence that the ratio of original cataloging to cataloging with LC card/copy changes with the introduction of automated services. However, we content ourselves with using the current ratio as an estimator of the future ratio for purposes of cost prediction.

4. Impact on Traditional Processes

After the types and level (extent or volume) of network products have been formally defined, current operations which will potentially change can be isolated. Data collection on current costs can be an expensive proposition. By determining the probable products which would be purchased by the library through each service, the possible impact points on current purchases have been indicated. The extent to which those impact points are defined in detail determines the amount of analysis (as well as accuracy) necessary to account for the present cost of tasks which will change. There are several levels of costs which can be included in this analysis including labor, equipment, supplies, and overhead.

Labor within a manual system can account for between 70% and 90% of the total costs of processing. Due to the labor-intensive nature of libraries, analysis should focus on labor costs of present operations. Direct labor costs include salaries and fringe benefits (including insurance, unemployment, retirement, educational fees, and any other dollar expenditures made on behalf of the employee by the library) paid out to persons working on the "production line." Such costs can be specifically related to those operations of processing and to the task levels, mentioned earlier, but not to the non-assignable time of staff devoted to supervisory tasks.*

In predicting direct labor costs, it often suffices to take an average hourly rate for the position rather than the individual. In other words, the exact salary of Ms. X is not as important as the average salary of an associate librarian (the position which Ms. X presently holds, but may not hold next year). Methods to estimate the labor costs of those tasks isolated as change candidates (activities that will be modified or eliminated through use of network services) include: management "guestimate," annual budget figures, time studies, and recollection of staff. Management guestimate relies solely upon the manager or analyst and his/her expectations of how much time is spent on change candidates in order to complete a unit of work. The relationship of the guestimate to reality depends on the experience of the estimator with the process and the estimator's intuitive capabilities. This is a relatively cheap and inefficient method of estimating present costs of change candidates.

Annual budget figures may be more reliable, depending upon the detail of the information available. If expenditure figures reflect labor for discrete tasks (e.g., card production), some estimations can be made. Caution should be employed in assessing the accuracy of these data. The time devoted to non-production activities (e.g., telephone answering, errands, etc.) cannot be isolated and may inflate the estimates of costs for processes. Most libraries do not have task level budget information. In these cases, it is more appropriate and accurate to collect data on current operations.

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* Industrial standards for the "productive" to paid hours ratio is about 82.5%. However, within offices and libraries, the indications point to about a 70% productive level. This would include sick leave, vacation, holidays, coffee breaks, personal time and delay allowances, and fatigue factors.

The expense of data collection and analysis is high and should be limited only to those activities which are change candidates. Collection of time data can be done informally (requesting each staff member to "recall" times and volume throughput) or rigorously (following each staff member with a stop watch). Normally, the more elaborate the data collection method, the more costly it is. In any study of staff time, the experience of the staff member, the time s/he is involved in data collection, the pressure upon the observed, and the times of year and day affect the validity of the data. The time of day may reflect the fatigue level of the observed, while the time of year (if work-flow is uneven) will influence the times of start-up and wind-down which are averaged across the volume throughput.

There are other costs in addition to those of direct labor which can be addressed: 1) supplies utilized strictly within change candidate activities (e.g., catalog cards); 2) machinery directly associated with these operations (e.g., photocopying equipment); and 3) overhead. The extent to which activities are affected by network services indicates the extent to which the corresponding supply requirement is also affected. Thus, if we abolish card production, for instance, there is no need to purchase card stock. Similarly, if card production is expected to be reduced by half in throughput, then purchases of card stock will be halved. Further, there may be supplies not directly associated with a change candidate that could be considered obsolete with the introduction of network services (e.g., proof slip subscription, certain bibliographic tools, etc.).

Equipment costs incurred must be analyzed differently. There exists a very significant hazard to including equipment costs in calculations of current operations to be compared with future costs. Unless there is evidence that equipment will be removed from the library, rather than simply changed in utilization, the inclusion of equipment cost is misleading. In the event that network services assume a portion of the tasks conducted with the equipment (but not all), the center of cost has simply shifted. The library must still pay for the equipment in another function.

Another area of costs which can be misinterpreted in cost-impact assessment is that of overhead. There are two types of overhead which are most often subject to costing: administrative and facility. The costs of library administration, personnel functions, accounting, and related support services are normally included in administrative overhead and allocated across production functions by production labor time (i.e., full-time equivalencies are used as the unit of costs). In practice, the administrative overhead is added to the direct labor costs proportionate to the direct labor time. The use of administrative overhead in cost comparisons (between present and future processing) is not encouraged unless there is significant evidence that the total costs of administration, personnel, etc. will be reduced due to the introduction of network services. Network services shift the center of cost for administration; they do not necessarily reduce them.

Facility overhead consists of costs for the library building, maintenance, insurance, electricity, facilities for staff (rest rooms, closets, etc.). Facility overhead is usually costed according to the amount of building space utilized by a particular function (square or cubic feet, depending on the type of facility cost). For somewhat different reasons, inclusion of this overhead factor is discouraged. First, it is doubtful that the library will be abandoning building space, so the cost of facilities is unaffected by the service. Secondly, it is unlikely that the functions impacted by services will be moved from the space they currently occupy. Thus, inclusion of facility overhead becomes academic.

The degree of product completion (e.g., catalog cards could be received sorted ready for filing in your catalog, or might instead be received in a pack that you would have to prepare for filing) and product quality varies among network services. The levels of product "completeness" that each service offers will affect the expected amount of manual labor to be displaced in the using library. Thought should be given the classification scheme employed by the library as compared with that of data base records. If, for example, Dewey Decimal classification is used, and the majority of records in the data base reflect only LC classification, staff time must be devoted to adding the proper classification on catalog cards received from the supplier. The extent to which cards received from each alternative supplier will need revision, sorting, prefiling, and filing must be carefully estimated. For example, if a product provided by one of the alternatives required 75% of the same local support required for current processing, while a more highly priced alternative required only 50% of that effort, the latter alternative might be less costly. By identifying those tasks which will remain to be done by staff to complete the processing supported by network services, the library manager can begin to appraise the effect on staffing requirements given the use of network services.

The quality of the products offered by alternatives may be an important decision factor. Depending upon the library's goals, increased quality may outweigh any other factor. However, for the purposes of explanation, let us assume that the library manager is interested in maintaining the same level of quality as experienced with current processing.

Quality should be defined for the sake of analysis in terms of standards for products. The standards should be quantifiable where possible for the sake of measurement and comparison. For instance, if a standard for cataloging includes extent of record, sources of record, record format, etc., then supplier data bases and products for cataloging can be evaluated for the degree to which they conform to the standard. The policies of the library regarding acceptance of member input records, classification structure, and the rigidity of standards should be weighed. The most valid method to determine the relative qualities of products and services offered is to analyze product descriptions and then examine a number of records and product samples to determine their content, format, completeness and adherence to your library's quality standards. You should estimate the amount and method of revision required for network products, either for purposes of finishing, or of standardization. Revision of records accomplished at the terminal (prior to producing cards) will likely use less labor than revision of the products upon receipt.

5. New Processes for Utilization of Network Services

New processes introduced into a library by network services may include:

- Terminal use
- Revision of products purchased
- Correspondence with the supplier and other network members
- Accounting for network services
- Waiting times (queues at terminal, down time)

We have already discussed product revision. Correspondence and accounting for network services are elusive cost factors and need not be considered essential to prediction of network costs. Terminal use is dependent upon: 1) the types and volume of services procured; 2) complexity of system use; 3) amount of record revision performed at the terminal; and 4) the numbers of terminals, terminal operators and length of response time.

Complexity of system use affects both the amount of training required and the staff time necessary for continued operations. Variables such as complexity of file structure, response times, and terminal procedural language affect terminal use and productivity. Considerations which should be examined when assessing network alternatives include:

- average times per search of the system by type of strategy (LC number, ISSN, author, title, subject) and by type of use (ILL, cataloging, etc.)

- average times for successful and unsuccessful searches

- average times for record revision, updating, inputting, etc.

- the average response rate of the system by type of search (how much time does the operator spend waiting)

C. NON-COST FACTORS TO CONSIDER

Alternatives cannot be chosen on cost factors alone. The library does not pay only in monetary terms, nor is the reduction of costs the only benefit. Thorough evaluation of the potential losses incurred by network membership should be studied. The loss of personnel and library positions, the abandonment of manual processes can preclude the ability to return to traditional modes of activity. There is a cost associated with losing the last cataloger, or clerk, which may exceed the salary savings.

There is an associated loss of options when the final decision is made regarding network services. Beyond the inability to return to the current methods, there may be an inability to select other alternatives in the future. The measure of commitment which is given the network supplier, the investment placed in the system, the number of records donated to the data base, can influence the library's willingness to withdraw from the network, or choose another supplier.

In a sense, the library may lose its autonomy: of control over standards, over the directions of services and product development, over the funds invested in the system. Participation in a "membership" requires an additional adherence to the policies and procedures dictated by the body of the membership, rather than local selection. Further, the library loses a portion of its anonymity. The collections of the library are publicized through the data base, for use by other libraries. Automation, itself, may bring with it unwanted organizational changes. Network services may increase the burdens placed upon the staff. The stress upon original catalogers to "perfect" their product for input in anticipation of the scrutiny of other catalogers can be great. Increasing interlibrary loan requests requires more than nodding recognition. It is impossible to estimate the increased demand placed upon the library by network services, but is probably related to the number of records used for cataloging production by the library, the number of participating libraries within the state (which can request in-print materials) and the number of local interlibrary loan restrictions (policies and charges). Regardless of restrictions placed on the circulation of materials through interlibrary loan, the potential growth of incoming requests from other network libraries should be an anticipated phenomenon. Perhaps of equal distress to the interlibrary loan department is the volume of requests for materials still in-process, though already input to the data base.

Automation may be unable to adapt to short-run changes or special modes of processing. During idle periods of production, machinery may remain unused. Under manual operations, staff could be floated to other activities within the library at slack periods. Thus, the introduction of automation may deter library flexibility. Further, the system's capability to cope with exceptions (e.g., rushes) is limited. The ability to process materials at a higher rate through the system may cause backlogs in successive operations. For instance, the ability to catalog materials quickly may only cause a backlog in materials finishing. Increasing throughput of one task within processing does not necessarily imply that other tasks can complete their processing any more quickly or any earlier than was previously the case. Outputs of automation are not easily changeable or correctable. For instance, card stock employed in network service production may prohibit erasing errors, or making additional annotations. The amount of time to correct a faulty product may be greatly increased by the need to use an automated system rather than making a "fix" on the spot. These are "costs" to the library as well.

D. COMPARING ALTERNATIVES

In summary, the library manager needs to assess the overall effect of each network service alternative upon the library, the value of the services, and their impacts upon input/output ratios. We have mentioned three sets of factors the library manager must consider: costs; utilization (extent, volume throughput, level) of network services; and changes in type and configuration of processing done in the library. The first two considerations are perhaps the easiest to perceive. Assuming that product cost and utilization have been determined, and that the costs of new tasks and changed tasks can be estimated, the library manager is now able to assess each network alternative with some degree of certainty greater than simple blind choice.

Returning to the input-process-output model described earlier, we can begin to determine changes in input requirements, changes in process requirements, and changes in output levels. It would be nice if input requirements would be reduced; however, this would be unlikely. Rather, the mix of inputs may change -- the library would invest capital in the network service and products offered instead of investing in salaries or equipment. It is fairly straightforward to determine what trade-offs the library manager is making when he purchases network services -- where would the money invested in network services be invested if no purchase was made. Given this choice, the library manager must decide the most efficient use of resources -- are the benefits greater for the money invested in network services rather than additional staff, additional equipment, etc.

The simplest way to determine this is to evaluate the changes in the mix and value of outputs expected with each network service alternative. There are some hazards involved in weighing these output benefits. As discussed earlier, network services present new products (e.g., new types of statistics, new catalog formats) as well as potential for new services (e.g., interlibrary loan communications). Again, we must return to the concept of "worth" -- how much is the library manager willing to pay for such new capabilities. Unfortunately, placing a value on these new outputs is difficult because there is no similar traditional output to which the new service can be compared, or for which the new service will be substituted. In getting around this difficulty, it may be possible to rely on a comparison of present outputs measured against similar network service outputs. The most concise manner of such estimation is simply to measure the present resources necessary to produce the present outputs (or, a unit of output) against the expected resources necessary to produce the same level of outputs. This methodology, employed in appraising each network service against others, and against traditional processes, ignores, however, the additional benefits (and disadvantages) of network service. These should be factored in, at least subjectively, before making the final selection decision.

V. INTRODUCING NETWORK SERVICES INTO THE LIBRARY

The introduction of network services into the library demands a considerable investment in planning and preparation. The introduction phase may be assumed to extend from the decision to purchase a particular service through to the end of the training period. There are several areas to be addressed in planning for the introduction of network services:

- Profiling
- Staff attitudes
- Management attitudes and policies
- Training
- Terminal requirements, and
- Procedural adaptation

Profiling, or defining the detailed specifications for products and services required of the contractor, is an excellent base for beginning planning. The library manager is made fully aware of the numbers of receiving catalogs and similar files that staff actually maintain, and the variances in the formats of inputs to these catalogs and files. Discovery of duplications in catalogs may indicate the potential for combining receiving catalogs or abandoning some. Thought should be given to "streamlining" library catalogs and requirements at this time.

Attitudes of library personnel towards automation may reflect an underlying perception of a threat to job security, and defensiveness about the present quality of work. Management responsibility to counteract these anxieties can, if ignored, encourage disuse or misuse of the system. Staff attitudes should be surveyed and weighted in the selection of an alternative, and in preliminary planning interventions. The inclusion of key staff in planning, and briefings occasionally of all other staff members, will go far in ensuring a receptive attitude toward the introduction of network services. Staff should be made aware that there will be hitches and some problems in making the transition to procedures based on new technology.

Management attitudes can affect the attitude of the rest of the staff towards network service introduction. By portraying network services as making a staff reduction possible, it can be expected that staff will resent the services. Special care should be taken in assuring those in affected positions that any staff cut-backs will be made only as a result of attrition. Management attitudes towards network services can equally affect the areas of cost-savings (if any). For instance, if network services are intended to supplant clerical, rather than professional tasks, the savings from the use of the service are lower than if the opposite intentions were realized.

Management policies concerning network services use and purposes bear directly upon the costs and effectiveness of the services. Management review of library processes and determination of requisite changes to adopt network services must be performed; if this review is omitted, it will be at the risk of minimal and peripheral service utilization. Network service, at the extreme, can be simply an expensive card production operation. Policy decisions regarding the use of network services can significantly affect utilization and costs (e.g., exclusion of use for interlibrary loan). These necessary policy changes should be anticipated by management, and effected through prior procedural adaptations by staff.

Training on the system requires careful planning of the numbers of persons to be trained, and for what purposes. Factors of concern should include:

- the experience of the trainee with present library operations (familiarity will avoid the need for extended training to acquire skills in both network services and library procedure);

- the ability of the trainee to learn proper use of the services; and

- the attitude of the trainee towards automation.

The skill level required for service use should also be factored into matching training with staff to be trained. Consideration should be given to the division of responsibilities among members of the staff:

- Who may produce records?
- Who may revise records?
- Who may search?

Delay in changing procedures in anticipation of network services will affect the immediate effectiveness of the services once introduced.

The number of terminals necessary for system use should be estimated carefully. The number is usually determined by the types and volumes of tasks expected to be handled through each terminal. Other factors would include the location of the terminal (a terminal housed in the cataloging department may discourage use by interlibrary loan or reference staff). Poor lighting can affect the visibility of records on the screen of a CRT and thus reduce expected production. The number of operators expected to use the terminal and the hours of use per day expected should be considered. If library policy prevents extended working hours over an eight-hour day, then the number of terminals required may have to be increased. Serious thought should be given to extending the working hours of technical processing staff and other users or working split shifts to make use of most of the hours in which network service may be available. Any such policy change is dependent upon staff willingness to adjust to these hours.

The scheduling of terminal use should be planned. If the terminal(s) is to be in full use throughout the day, a preset schedule should be established to prevent queues (waiting lines). Waiting time by staff members will increase the cost of processing materials (i.e., reduce the productivity of the system). Scheduling should take into account fatigue level of operators, time requirements for each type of use and expected amounts of system down-time.

Adjustment in procedures, formal or informal, should be instituted within a few weeks or months after the services have been introduced. These changes normally incorporate more efficient practices invented by staff as they acquire experience with the new tools. As soon as the terminal is in place, pre-introduction changes should be re-examined. For instance, policies on operators and operator responsibilities might be too rigid for effective and economic use of network services. Manual operations (e.g., accessioning) might be abandoned, searching techniques improved, etc. The same questions asked of the manual operations (e.g., Who? How? Why? What purpose? Where? To what value and for what cost? How many?) might be asked of the automated operations.

Thorough review should be given to the cataloging revision and acceptance policies. If there is a high rate of revision, it becomes less economical to purchase network services than to maintain traditional forms of processing. This should be of particular concern to libraries requiring major record revisions on all data base entries.

Detailed post-introduction evaluation of network services should be delayed until the learning curve has begun to level off. The learning curve is an indicator of the assimilation of skills by staff necessary to use a new tool or process. Figure 2 indicates the shape of such a curve, and shows that productivity tends to be low initially. There is no method of predicting what the learning curve will be, nor at what time it will begin to level off. Every new tool or operation presents a different learning curve. Some processes which are similar, and for which the library manager has data, may be useful in estimating the learning curve of a similar new process. This is better than starting with a zero estimate for the learning curve (i.e., a horizontal line). However, it is difficult to find operations comparable to those involved in network service utilization. The library manager may be content waiting until such time as all adjustments and training appear complete.

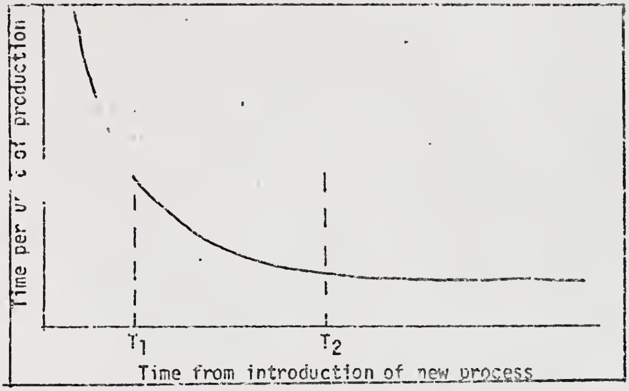

Figure 2. Learning Curve. An evalation performed at time T_1 may give misleading results because efficiency is still rapidly increasing as staff learn how to use the new process. By time T_2 operations have reached a stable state, and evaluation results should be valid.

VI. EVALUATION OF THE DECISION

Evaluation of the decision to select and procure network services can be simply an exercise in self-vindication or rationalization. However, evaluation can be a means for monitoring the quality of the system, the effectiveness of network services utilized in the library, and the efficiency of the staff in use of the services. Evaluation is primarily a repetition of the investigation into costs performed previous to the introduction of network services and a measurement of the change in the library's value function. Moreover, there should be continual monitoring of output volume and quality (throughput), and input requirements. Certain areas can be identified in which continual data collection may be required, but most areas can be monitored with only occasional, or sample, data collection and analysis.

Evaluation is based upon measurements which assist the manager in determining the status (value) of library services. Measurements can be factored into input measures, output measures and process measures. The library manager is concerned with the input requirements of the new services:

- Incoming volume for the areas of service use (cataloging, acquisitions, ILL, etc.)
- Labor requirements for service use,
- Equipment and supply requirements,
- Payments to the network service supplier

Further, the manager is interested in the process times (turnarounds, productive labor times) and in process delays (backlogs, queues of materials). Finally, there are the measures for outputs: intermediate products and services accomplished with the aid of the network services, and the finished products delivered to users, internal or external (e.g., completely processed materials, purchased materials, received completed interlibrary loan requests). The library manager will want consistent measures of these statistics for comparison over time. Comparison with previous measures instituted before introduction of network services will help evaluate the results attained from the new methods against those offered by traditional modes of production:

- turnaround times (of requests, of processing, etc.)
- backlogs or queues (of requests, of materials, etc.)
- labor proportions (professional staff: library assistant staff, technical processing FTE: public service processing, etc.)
- input/output ratios (costs: outputs, labor: outputs, cost increases to value increases, etc.)
- system downtime (a process deficiency)

Turnaround, backlog, and queues can be economically measured on a sampling basis. As mentioned earlier, many of the statistics (both input and output) will be available through the network service itself. By using these statistics effectively, the library manager can maintain adequate evaluative information to monitor the system use and production.

Quality control can be a costly endeavor if performed extensively. The amount of quality control required is a function of the quality and volume of the product and services purchased from the system. Under most conditions, the buyer pays more for consistent high quality. If the buyer of the products must perform testing and revision (despite the level of quality for the products) then there is no apparent need for the supplier to add costs for quality control. In the library world, measurement of quality is not simple, on the part of either the supplier or the user. Guarantees of high quality bibliographic records may be difficult to obtain from network service suppliers. However, levels of quality control needed, and the mechanisms employed for measurement of quality, should be analyzed. The cost of such control should be carefully measured against its "value." Is it really worth the effort? The error rate of products and services may be sufficiently low to make it impractical to perform even the more cursory methods of control. If quality control is initiated, care should be taken in assigning the responsibility at a point in the local procedure where the products would have to be surveyed or handled anyway. For instance, cards can be checked during the filing process.

Though there are few opportunities to change the decision, if evaluation and quality control prove that the system is not meeting expectations, a concerted effort to make operations more efficient may remedy the disappointment. Further, the library manager should look at all areas of use of the network service for benefits accrued through system use. In other words, the library manager may have started with some invalid expectations which now need revision in the light of reality.

The potential of network services for increasing productivity and value of library service is foreshadowing a revolution in the field of library science. At the same time, network services are not a panacea for every existing library problem. The services themselves cannot counteract poor management, inefficient procedures or inadequate resources. These are problems which demand local resolution, and network services may only magnify the difficulties. Further, the growing pains of change and the requisite adaptations to network services have the potential, if not well managed, to damage many of the strengths of traditional modes of library service. Progress is coupled with loss, and accompanied by nostalgia.

APPENDIX

For those readers wishing to pursue in full detail the methodologies employed in this paper, basic texts in decision-making, cost analysis, and mathematical programming may prove of value. The basic concept employed in this paper is modeled after a non-linear programming problem with the following system of equations:

Maximize $V(s,c,a_c,a_r,\ldots)$

subject to. $C(l,k,b,t,a_t,\ldots)$
dC/dx greater than 0 for all $x=l,k,b,t,a_t$ and y greater than or equal to 0 for all $y=s,c,a_c,a_r,\ldots$

where:
V=value function, determined in practice by the library administrator, who guesses the value to the public of a given mix of outputs.
s=service to the user (whatever that means)
c=control and maintenance of the collection (whatever that means)
a_c=access to the collection (whatever that means)
a_r=access to the resources outside the library (whatever that means)

C=cost function, also guessed at in practice by the library administrator, and considered to be a mix of the inputs.
l=labor (staffing, skilled/unskilled, etc.)
k=capital (e.g., equipment)
b=inventory (i.e., backlog)
t=turnaround
a_t=access to bibliographic or location tools
i=interlibrary cooperation

Clearly, by modifying values for the elements of the cost function, labor, capital, inventory, etc., and reallocating these elements among activities (e.g., circulation, reference, etc.) it is possible to vary the value function for any given cost distribution. Because of the interdependence of inputs and outputs, there is a parallel function, with which the library manager is concerned. This is the conservation of resources, which we will call a cost function. The cost function is a function of capital, labor, land and raw materials and is subject to the constraints of service production. The library manager chooses to maximize the value function (according to the constraints of input) while simultaneously minimizing the cost function. He may:

- Maximize value to the public subject to the restraints or resources, or
- Minimize cost of production, subject to the restraints of service.

In this Handbook, we have been primarily concerned with the cost function, because factors of the cost function are more "measurable" than those contained in the value function. However, the reader should be aware that these are interrelated functions, and by solving for one, we essentially have obtained an answer for the other.